

ORIGINAL ARTICLE

Comparison of Outcome of Lateral Pinning Versus Medial and Lateral Cross Pinning in Childhood Supracondylar Fractures of Humerus

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ABSTRACT

Objectives: To compare the complications and outcomes of lateral entry pin fixation with medial and lateral pin fixation for Gartland type III supracondylar fractures of humerus.

Methodology: This prospective comparative study involving 190 patients of Gartland type III close supracondylar fractures were included. From March-2019 to Dec-2020. In all patients, initially the elbow was mobilized using the splint placed above the elbow joint at 30 to 45 degrees' flexion. After closed reduction, lateral pinning was applied in group I and in group II lateral and medial cross pinning was applied using the standard protocol. Patients were followed for iatrogenic ulnar nerve injury, radiologic and function outcomes in-terms of loss of reduction, elbow range of motion, loss in carrying angle and functional outcomes.

Results: The two groups were comparable for loss of elbow range of motion, loss of carrying angle and loss of Bauman's angle. On clinical examination, immediate post-operative ulnar nerve injury was diagnosed in 4 (4.2%) cases in group II and in no patient in group I (p-value 0.12). Satisfactory functional outcomes were achieved in 85 (89.5%) patients in group I and in 88 (92.6%) patients in group II (p-value 0.44).

Conclusion: Lateral pinning provided stable fixation clinically and radiologically as compared to lateral and medial cross pinning.

Keywords: Supracondylar fracture of Humerus, iatrogenic ulnar nerve injury, Lateral pin entry, lateral and medial cross pin entry.

INTRODUCTION

Supracondylar fractures of humerus are reported to be the commonest injuries involving the elbow region. These fractures accounts for up-to 55 to 80% of all fractures of elbow region with peak occurrence in age 4 to 7 years.¹ The fractures commonly occur during sports or leisure activities or as a result of fall from height.² Incidence is higher in male children and the chances of fracture are 1.5 times higher in non-dominant arm.³ Supracondylar fractures are classified into extension and flexion types; the extension type is more common accounting for about 97% of the total fractures.⁴ This supracondylar region is at higher risk of fracture because of its anatomical structure. It's a thin area connecting the olecranon and coronoid fossae and therefore has higher predisposition to bending forces during fall from height.⁵

The supracondylar fractures are difficult to treat with a significant risk of immediate and delayed complications such as occurrence of compartment syndrome, nerve damage, ischemic contractures and mal-union.^{6, 7} Percutaneous pinning is the standard of care for treating supra-condylar fractures. The two methods of pinning are lateral pinning only and medial and lateral pinning technique.⁸ The optimal pin fixation stabilizes the fracture and reduces the risk of neuro-vascular injuries. The medial-lateral approach provides theoretical benefits in-terms of increased bio-mechanical stability. However, placement of medial pins can increase the chances of ulnar nerve injury. On the other hands, lateral approach reduces the risk of nerve injury but provides lower biomechanical stability.^{9, 10}

In this study we compared the complications and outcomes of lateral entry pin fixation with medial and lateral pin fixation for Gartland type III supracondylar fracture.

METHODS

This prospective comparative study involving 190 patients of Gartland type III close supracondylar fractures was conducted in the department of orthopedic Islam Medical College and Khawaja Muhammad Safdar Medical College, Sialkot. The study was conducted between March-2019 to Dec-2020. The inclusion criteria was age 3 to 10 years, and no concomitant fracture of the same limb, and presentation in the hospital within 24 hours of injury. Patients with bilateral fractures, and patients having evidence of neurovascular damage on clinical evaluation were excluded.

The patients were divided into two equal groups. using computer generated random number tables. Initially the elbow was mobilized using the splint placed above the elbow joint at 30 to 45 degrees' flexion. The protocol for surgery was standardized for all patients. In patients of weight <20 Kg pin size of 1.5 mm was selected and in patients of weight ≥20 Kg in pin size of 2.0 mm was selected. The surgical procedures were performed under general anesthesia. Closed reduction was done in all patients, after that longitudinal traction was applied. After applying traction, the lateral and medial displacement was corrected by applying varus/valgus forces. While the posterior displacement was corrected by applying force on the posterior aspect. The elbow was then smoothly hyper-

flexed and fixed in this position. The reduction was confirmed using the image intensifier.

In lateral technique, the pins were inserted in the lateral elbow place across the lateral cortex for engaging the medial cortex. The pins were inserted in parallel/divergent configuration by maintaining a safe distance from fracture area.

In lateral medial approach, the technique for lateral pinning was kept same as that for lateral only approach. While the medial pins were inserted to support the lateral cortex at <90 degree elbow flexion. The configuration of pins was one medial and one lateral pin in all patients.

The clinical and radiological examination was performed till six months after surgery at different intervals. The K-wire was removed at 3rd week in all patients and assisted mobilization was advised. During clinical examination, neuro-vascular status, carrying angle measurement, passive range of motion, and functional outcomes were determined. Clinical outcomes were determined according to the proposed criteria by Flynn et al.

Radiographic examination was performed as each follow-up to determine loss of Baumann angle and Humerocapitellar angle. Elbow was also evaluated for major functional loss, minor loss and full function. Carrying angle loss >10°, loss of elbow range of motion >10° and Baumann,s angle loss >06° was considered significant.

All data were compiled and calculated by SPSS V.17.0. Chi-square test was applied to compare the study outcomes between the groups. Repeated measures ANOVA was applied to determine mean changes in study outcome variables within the group. P-value ≤0.05 was considered significant.

Mean age of patients in group I was 6.32 ±1.92 years, while mean age in group II was 5.96± 1.88 years. Minimum age was 3 years and maximum age was 10 years. There were 122 (64.2%) male children and 68 (35.8%) were female children. The mean time from injury to admission was 7.04±4.90 hours in lateral pin group and 6.88±5.1 hours in cross pin groups. The mean time from admission to surgery was 12.578±4.04 hours in lateral pin group and was 12.47±4.03 hours in cross pin group (Table 1).

The mean loss of range of motion was 6.66° ±4.06 in lateral group versus 6.43°±4.11 in cross pinning group (p-value 0.69). Mean loss of carrying angle was 6.74°±3.18 in lateral group versus 6.62°±3.28 in cross-pinning group (p-value 0.82). Mean loss in Bauman's angle was 4.52°±1.71 in lateral pinning group and 4.49°±1.52 in cross pinning groups (p-value 0.89) [Table 2].

In group I 85 (89.5%) of patients had carrying angle loss <10° and 10 (10.5%) had >10° while in group II 88 (92.6%) had loss of carrying angle <10° and in 7 (7.4%) >10° (p-value 0.44). In group I 85 (89.5%) of patients had range of motion loss <10° and 10 (10.5%) had >10°, while in group II 88 (92.6%) patients had loss of elbow range of motion <10° and 7 (7.4%) had >10° (p-value 0.44). In group 1 85 (89.5%) of patients had Baumann angle loss <06° and 10 (10.5%) had >06°, while in group II 88 (92.6%) had loss of angle <06° and in group II 7 (7.4%) had >06° (p-value 0.44) [Table 2].

On clinical examination, immediate post-operative ulnar nerve injury was diagnosed in 4 (4.2%) cases in group II and in no patient in group I (p-value 0.12). Satisfactory functional outcomes were achieved in 85 (89.5%) patients in group I and in 88 (92.6%) patients in group II (p-value 0.44) [Table 2].

RESULTS

Table 1. Comparison of Baseline Study Characteristics.

	Group I (Lateral Pinning)	Group II (Cross Pinning)	p-Value
Mean Age (Y)	6.32±1.92	5.96±1.88	0.19
3-5 Years	35 (36.8%)	41 (43.2%)	0.78
6-10 Years	60 (63.2%)	54 (56.8%)	
Gender			
Male	64 (67.4%)	58 (61.05%)	0.82
Female	31 (32.6%)	37 (38.9%)	
Time from injury to admission	7.04±4.90	6.88±5.13	0.82
Time from admission to surgery	12.57 ±4.04	12.47±4.03	0.85

Table 2. Comparison of Study Outcomes.

	Group I (Lateral Pinning)	Group II (Cross Pinning)	p-Value
Loss of Elbow Range Motion	6.66±4.06	6.43±4.11	0.69
Loss of Carrying Angle	6.74±3.18	6.62±3.28	0.82
Loss of Bauman Angle	4.52±1.71	4.49±1.52	0.89
Carrying Angle Loss > 10°	10 (10.5%)	07 (7.4%)	0.44
Loss of Elbow Range Motion > 10°	10 (10.5%)	07 (7.4%)	0.44
Loss of Bauman Angle > 6°	10 (10.5%)	07 (7.4%)	0.44
Neurological Deficit	0 (0.0%)	4 (4.2%)	0.12
Satisfactory Functional Outcomes	85 (89.5%)	88 (92.6%)	0.44

DISCUSSION

Supracondylar fractures are the commonest fractures around the elbow in children⁵⁵. Treatment is based on degree of displacement and neurovascular status.¹¹

Present study focused on Gartland type III fractures which are completely displaced and are source of concern too. So the seriousness of fracture led to evolution of many treatment options ranging from traction to open surgery.

Open reduction is valuable for irreducible fractures or fractures which required exploration for vessel or nerve injury. Now the open method has been replaced by close reduction along with percutaneous pinning. Primary goal of which is to achieve stable reduction with safety to avoid redisplacement of distal fragment that may lead to varus deformity.

In the past cross pinning was the most favorable pinning technique and still favored by many citing it as the most stable construct as both lateral and medial column are engaged. However, cross-pinning carries high risk of iatrogenic ulnar nerve injury.^{12, 13} The alternative of cross pinning is lateral pinning or Dorgan's technique; this technique confers stability as well as avoids iatrogenic ulnar nerve injury.¹⁴

Lee et al. in a study on saw-bone model, reported the lateral pins are equally effective (in terms of extension, valgus/varus loading) to cross pinning, but are inferior regarding axial rotation. This finding correlated very well with our study where lateral pinning was equally good in torsional strength to medial and lateral cross pins.¹⁵

Prashant et al. conducted a study on outcomes of lateral versus cross pinning technique for managing supracondylar humeral fractures and did not find any significant difference in radiological and clinical outcomes and damage to ulnar nerve and reported that both of these techniques are equally effective.¹⁶ Another study by Naik et al. also reported no significant difference in functional outcomes between the lateral and cross-pinning techniques.¹⁷

Another recent meta-analysis by Kwok et al. including 11 studies reported that lateral pinning is associated with higher loss of reduction and had lower risk of iatrogenic ulnar nerve injury.¹⁸

In our study, the radiologic and functional outcomes were almost similar between the groups. But there was difference between two techniques in safety of ulnar nerve as there were four injuries to ulnar nerve in cross pin group (4.2%) and none in lateral pin technique which were neuropraxia type and recovered fully in 3 months.

In our experience we found lateral pinning to be a safe alternative in cross pinning. Moreover, this provides adequate stability to reduced fracture if pins are applied according to the protocol that is to maintain space between the pins at insertion by more than 10 mm and pins should be divergent and occupy both lateral and medial column before the fracture line. Due to its safety, this technique is now the first option for many surgeons in the world.

CONCLUSION

Both lateral and medial and lateral pinning are standard methods of treatment in displaced type III fractures. Lateral pinning should be the preferred choice keeping safety profile in view but if surgeon has doubts on the stability of fracture reduction medial pin option can be exercised taking well care of insertion technique.

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